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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

Technical Memorandum No. 10.

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THE LAW RELATING TO AIR CURRENTS.

Translated by Paris Office, N. A. C. A.

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THE LAW RELATING TO AIR CURRENTS.*

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The Subdivided Wing Section.

In accordance with the Bernoulli equation, lift is a result of the formation of layers in a circulating current with forward movement of a cambered surface. The separation of the streamlines at the top side of a plate placed obliquely to the direction of the current results in a vacuum between an upper surface of discontinuity and the front of the top side, and this vacuum is filled with harmful eddies. It shows a cambered section above the "critical angle of attack". IN THE SUBDIVIDED PROFILE, the diagram of the current is entirely changed and the harmful formation of eddies is avoided through premature deflection. Pressure equalization DOES NOT OCCUR between the upper and under sides. "There is no occasion to fear diminution of the velocity on the top side, as the entire profile system is to be considered as a STAGGERED MULTIPLANE with independent single sections when there is sufficiently large SPACING of the dividing surfaces. The form of the transverse section is chosen in such a manner that the top outlet groove narrows down opposite the bottom one." In accordance with the principle of the VENTURI TUBE, there will be a subsequent increase in the high speed of the airstream

* "Nachrichten für Luftfahrer," Vol. 3, No. 3 pp. 46, 47, 48.

escaping through the upper slot. "In consequence of the centrifugal acceleration of the streamlines, new partial pressures arise through the CAMBERED lower side of the divided profile and add to the resulting total pressure." It has not, so far, been possible to prove this in practice in Germany. The HANDLEY PAGE tests confirm the theoretical expectations entertained, in spite of the extremely imperfect and contestable arrangement of those tests. With six divided surfaces, a GAIN of 200% to 300% in LIFT was expected. Wind-tunnel measurements made at the British N.P.L. also confirm the increase of lift with more acute angles of attack. There is no considerable increase of resistance in such case, and the tendency to MIGRATION OF THE CENTER OF PRESSURE IS NOT INCREASED TO ANY IMPORTANT DEGREE.

Tests on Engine Cars.

These tests were chiefly carried out during the war, not in a systematic manner, but to the extent required by various customers ordering them. The following limits were prescribed for MODELS: Sectional measurement, 6 - 20 cm.; greatest length 80 cm. for fuselages, airships, etc., the lightest possible, but with about 80 mm. thickness of wood in the region of the center of gravity to enable it to be secured to the balance. Maximum dimensions for wings and multiplanes: 80 cm. span, 12 cm. depth; as rigid as possible. Wings one behind the other or entire airplane: 40 - 80 cm. wide, 60 cm. long and

30 cm. high at most. A diameter of 60 cm., or at least, 30 cm. is recommended for the propeller. Maximum number of revolutions of model 4000 per minute, maximum velocity 30 m/sec., maximum power 2 HP. These values correspond - according to the scale of the model - to various values of the full-sized airplane.

The first series, a car model 1 : 5, from the Technical Direction of Military Aviation, was measured at the parallelogram balance and further verified at the Eiffel balance. The resistance was shown to be proportional to the square of the velocity. The measurements were taken at various angles of attack and torque.

The second series consisted of models $(DTAM)_2$ to $(DTAM)_5$, two with a square cross-section and two with a rectangular cross-section, alternately; and one of each of these two has a long engine shaft and a short one, also alternately. By this arrangement, the components are unsymmetrical. There was less resistance in the case of the short forms, but at angles beyond 10° (or 20° for rectangular forms) the resistance was greater. The resistance of the long square model is greater than that of the rectangular model; for the short square model, however, up to an angle of 20° only. The long square fuselage always presents greater resistance than the short rectangular form. The resistance of the long rectangular fuselage exceeds that of the short square one at angles of attack not greater than 20°. All this can be explained by resolving the resist-

ance into form and angle. The equation of lifting forces gives corresponding results.

The same models compose the third series of tests, but they are here BLOWN AGAINST FROM BEHIND, at the Eiffel balance. The influence of length is noticeable at high velocities, only, in this case, owing to the unfavorable wash at the end of the engine, which now lies with the wind. This position is more favorable for the short models.

The resistance is proportional to the square of the velocity between 25 and 40 m.p.sec.

With regard to the resistance of the different forms, the above statements may be applied, though the cross-sectional measurements are more marked in this case. The more acute the angle of attack, the greater is the influence of length in so far as lifting power is concerned. In opposition to the resistance, the lifting power is lower with the long square fuselage than in the case of the rectangular form, as also when the short models have greater angles.

The inverse position is more favorable for the long, square form at and below an angle of 5^{o}, and it is still more so for the short form. This is proved by the profile effect of the two halves of the model. The shape is of greater influence than the angle. The same applies to rectangular fuselages, but the critical angle is smaller.

Fourth series: Casing for TWO ENGINES on the scale of 1 : 10 $(ISA)_1$, also examined at the Eiffel balance. The coefficient of resistance diminishes with increased velocity.